Uncoated Weathering Steel Feasibility and Detailing

Uncoated Weathering Steel Feasibility and Detailing

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Structures Design Office

"I know nothing about the subject, but I'm happy to give you my expert opinion"

Disclaimer

Background

Estimated annual cost savings on new bridges under new policy

- New Construction of 555,000 SF of Uncoated Weathering Steel @ $8/SF - $4,440,000 annual savings
- 120,000 SF of One Coat Inorganic Zinc @$6/SF – $720,000 annual savings
- Assume 20% of new bridges qualify for aesthetic treatment.

Background

Painting & repainting bridges can be expensive. Many painting contracts involves:

- Mobilization
- Traffic Control and Detours
- Removal of Existing Paint & Surface Preparation
- Containment
- Environmental Monitoring
- Disposal of Hazardous Waste
- Inconvenience and Expense to the Travelling Public due to Traffic Slowdowns

Background

- FDOT's historic budget for repainting structural steel bridges is as follows:
  - 2012: $28,500,000
  - 2011: $27,400,000
  - 2010: $25,000,000
  - 2009: $25,500,000
  - 2008: $26,300,000

Policy Statement

"Where environmental/site conditions are appropriate for its use, uncoated weathering steel is to be used for all new steel I-girder and box-girder bridges. An Inorganic Zinc Coating System is to be specified for all other locations. Exemptions to these requirements may be obtained where aesthetic considerations warrant and written approval is granted by the Chief Engineer."

STRUCTURES DESIGN BULLETIN C12-02
ROADWAY DESIGN BULLETIN 12-04

Structures Design Bulletin C12-02

"Implementation of Requirements for use of Uncoated Weathering Steel and Coating Systems for Steel Bridges"

- Implementation:
  - All Design/Bid/Build Projects let after June 30, 2012
  - All Design/Build projects for which the Final RFP has not been released as of the date of this Bulletin
  - Construction projects let before June 30, 2012 may incorporate these new requirements subject to the Cost Savings Initiative Proposal provisions of Subarticle 4-3.9.

Design Bulletin Contents

- Defines hierarchy for selection of coatings for steel bridges
- Identifies site constraints for use of uncoated weathering steel
- Specifies steel painting notes to be included in plans
- Designates default Class 5 Finish color for use with uncoated weathering steel
- Provides plan details for use on uncoated weathering steel bridges

New Policy Requirements

- Uncoated weathering steel on all steel I-girder and box-girder bridges where environmental conditions allow
- Inorganic Zinc Coating System for all other locations
- Use of High Performance Coating Systems requires approval by Chief Engineer
- Not applicable to Bascule or Pedestrian Bridges

Widening of Steel Bridges

- Paint the widened (new Steel) portion of the bridge to match the existing structure.
- If the existing portion of the bridge is to be repainted, coordinate with the District Maintenance and/or State Materials Office for the type of coating system to be used.

UNCOATED WEATHERING STEEL

- Proven, effective corrosion control system
- Low maintenance
- Cost effective
- Requires specific site conditions
- Requires special details to control debris and runoff

UNCOATED WEATHERING STEEL

Weathering Steel

Weathered Steel??

WEATHERING STEEL

- High strength - low alloy steel
- ASTM A709 - Grades 50W, HPS 50W, HPS 70W, & HPS 100W
- Forms a tight oxide coating (patina)
- Expect 4 times the corrosion resistance of carbon steel
- Achieves 75 year design life unpainted with proper site conditions, design details, and maintenance

Design Considerations

Materials –

- Specify ASTM A709 Grades 50W, HPS 50W, or HPS 70W
- Specify ASTM A325 Type 3 Bolts
- Design Slip Critical connections for Class B faying surface

Hybrid Girders –

- Where Grade HPS 70W steel is required for flanges in high moment regions consider use of Grade 50W or HPS 50W for webs.

Detailing Considerations

Drainage Control –

- Avoid details that promote Ponding / Debris build-up
- Use sealed expansion joints. Avoid open joints that allow water and debris to collect on steel.

Substructure Staining –

- Incorporate details to prevent moisture from girders from running down face of substructure units/walls.
- Wrap substructure elements during construction where necessary

Detailing Considerations

Typical Substructure Wrapping

Maintenance Considerations

- Implement inspection procedures to detect and minimize corrosion.
- Regularly inspect and maintain deck joints. Control roadway drainage.
- Regularly remove all dirt debris, etc that trap moisture.
- Regularly remove surrounding vegetation which prevents natural drying.
- Maintain covers and screens over access holes.

Document Revisions

Modifications have been made to the following FDOT documents (Structures Design Bulletin C12-02) :

- Plans Preparation Manual
- Structures Design Guidelines
- Structures Detailing Manual
- Standard Specifications for Road and Bridge Construction (January 2012 Workbook)
  - Sect. 460
  - Sect. 560
  - Sect. 975

Preliminary Engineering

Preliminary Engineering

(PPM 26.9.4.2) "The default treatment for new steel I-girder and box-girder bridges is uncoated weathering steel where site conditions warrant (See SDG 1.3.2). An Inorganic Zinc Coating System shall be used where site conditions preclude uncoated weathering steel and may be used elsewhere with approval of the Chief Engineer. Use of a High Performance Coating System to any extent for Steel I-Girder or Box-Girder bridges requires written approval from the Chief Engineer."

The Engineer should make a determination as to the type of steel coating system required based on site environmental conditions early in the preliminary engineering or BDR phase.

If aesthetics or other considerations warrant use of a High Performance Coating system, the District must obtain written approval from the Chief Engineer.

For Design/Build projects this determination should be made prior to issuance of the RFP.

Site Environmental Criteria

(SDG Sect 1.3.2)

Site Environmental Criteria

Site conditions for the use of uncoated weathering steel superstructures shall meet the following requirements:

- The structure shall be located 4.0 miles or more from the coast.
- For structures over a body of water: Minimum vertical clearance over mean high water shall be at least 12 feet for a body of water with chloride concentrations less than 6000 ppm and 25 feet for of a body of water with chloride concentrations equal or greater than 6000 ppm.
- For structures adjacent to a body of water: Minimum horizontal clearance shall be at least 25 feet from a body of water with chloride concentrations less than 6000 ppm and 100 feet from of a body of water with chloride concentrations equal or greater than 6000 ppm.

Site Environmental Criteria (cont'd)

For structures located within 4.0 miles of the coast, the use of uncoated weathering steel superstructures may be considered if site conditions, as determined by the State Materials Office, satisfy each of the following criteria:

- The maximum airborne salt deposition rate, as determined by ASTM Test G140, is less than 5 mg/m²/day (measured over a 30 day period).
- The maximum average concentration for SO_2, as determined by ASTM Test G91, does not exceed 60 mg/m²/day (measured over a 30 day period).
- Yearly average Time of Wetness (TOW), as determined by ASTM Test G84, does not exceed 60%.

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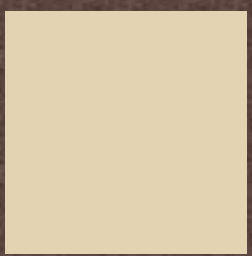
Class 5 Finish

(SDM **Sect. 4.4 & Spec.** 975-6.1)

Class 5 Finish

"If the finish color is other than Federal Color Standard No. 595, color No. 36622 (standard concrete gray) (or color No. 36642 for uncoated weathering steel bridges), specify the appropriate number(s) for the desired color(s)."

No. 36622



No. 36642

Steel Painting Notes

(SDM Sect. 5.3.F)

Steel Painting Notes

Include one of the following notes in the plans as applicable:

1. Weathering steel is to remain uncoated, except as required by the Specifications. (Steel Box-Girders)
2. Paint the outside face and bottom of Exterior Girders with an Inorganic Zinc Coating System. Interior Girders and diaphragms/cross-frames are to remain unpainted.
3. Paint the outside face and bottom of Exterior Girders with a High Performance Coating System. The color of the finish coat shall conform to Federal Standard No. 595, Color No. XXXXX. Interior Girders and diaphragms/cross-frames are to remain unpainted.

Steel Painting Notes (cont'd)

4. Paint all steel with an Inorganic Zinc Coating System.
5. Paint the outside face and bottom of Exterior Girders with a High Performance Coating System. The color of the finish coat shall conform to Federal Standard No. 595, Color No. XXXXX. Paint Interior Girders and diaphragms/cross-frames with an Inorganic Zinc Coating System.
6. Paint all steel with a High Performance Coating System. The color of the finish coat shall conform to Federal Standard No. 595, Color No. XXXXX.

Weathering Steel Details

(SDM Sect. 16.12)

Uncoated Weathering Steel Details

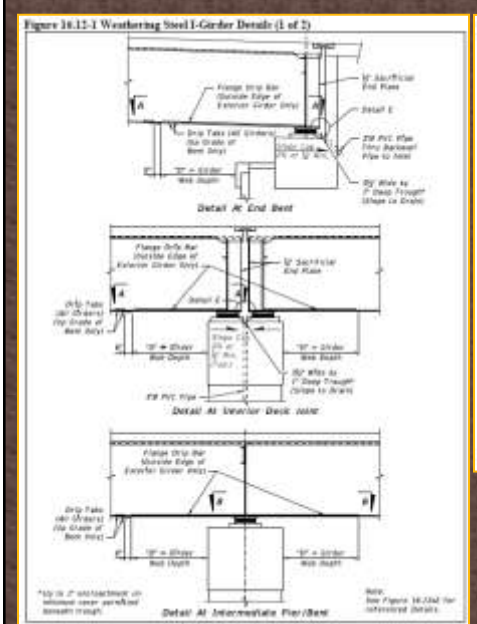
The following details are required for uncoated weathering steel bridges.

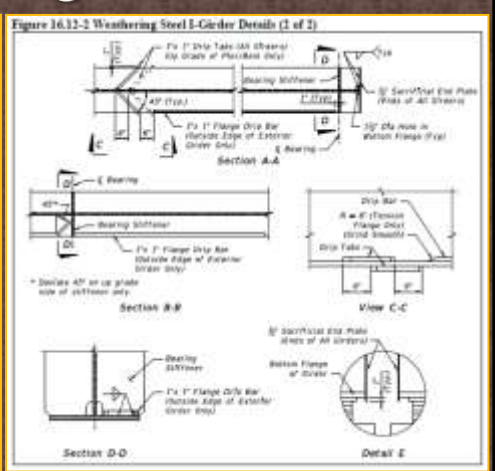
- Provide Drip Tabs on the bottom flange of all box-girders and I-Girders up grade from each pier/bent to divert runoff water.
- Provide Drip Bars along the outside edge of exterior I-girders to channel runoff water past piers/bents or to pier/bent troughs adjacent to girder ends.
- Slope the caps at all end bents and piers located at deck joints. Provide troughs or other means to drain water from the cap to an embedded pipe drain.

Uncoated Weathering Steel Details

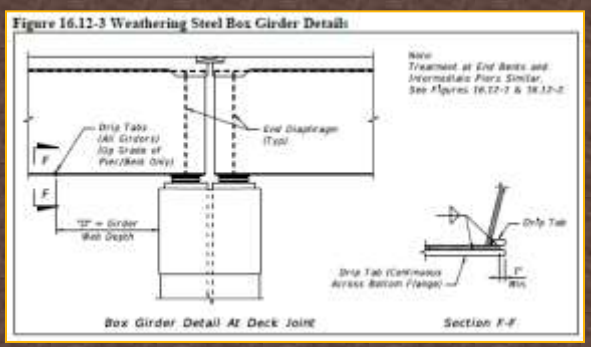
- Provide a 1/2" thick sacrificial end plate at the ends of all I-girders to protect girders from leaky joints.
- Use sealed expansion joints. Avoid any type of open joint that allows runoff to reach the steel.
- Provide details that take advantage of natural drainage. Eliminate details that retain water, dirt, and other debris.
- Paint the interior surfaces of box girders.
- Paint the exterior face of end diaphragms of box girders.

Uncoated Weathering Steel Details

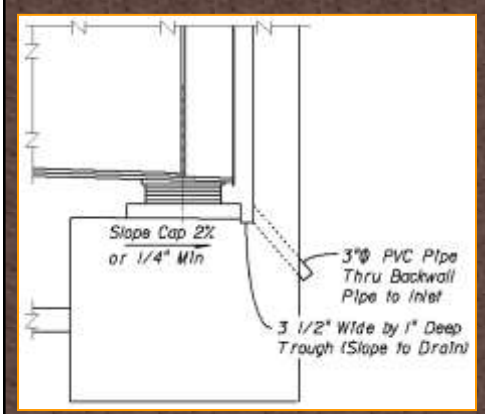




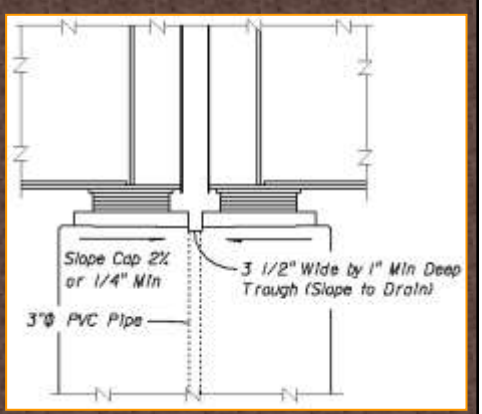
Uncoated Weathering Steel Details



Weathering Steel Details

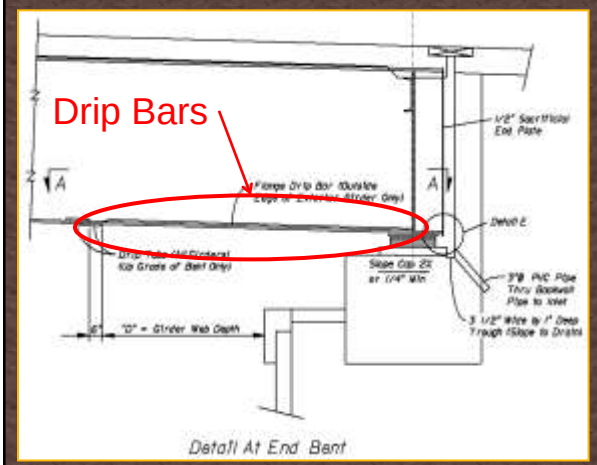


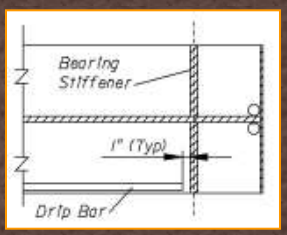
End Bents

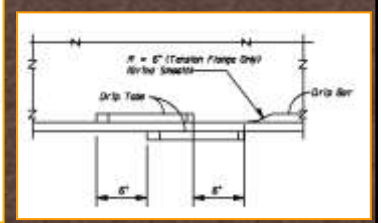


Intermediate Piers at Deck Joints

Weathering Steel Details







Drip Bar Details

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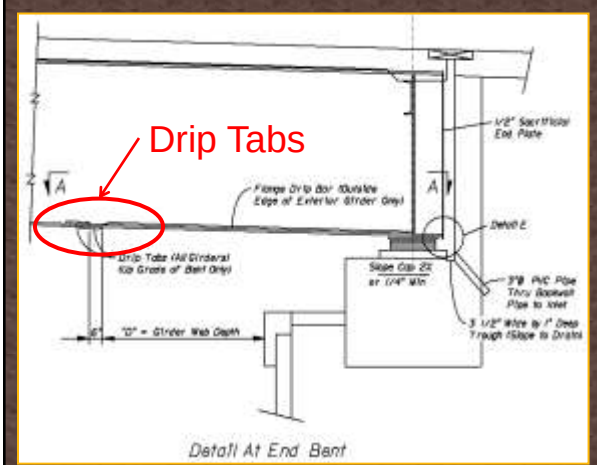
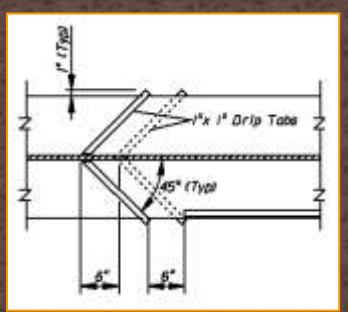
Weathering Steel Details





Drip Tab Details

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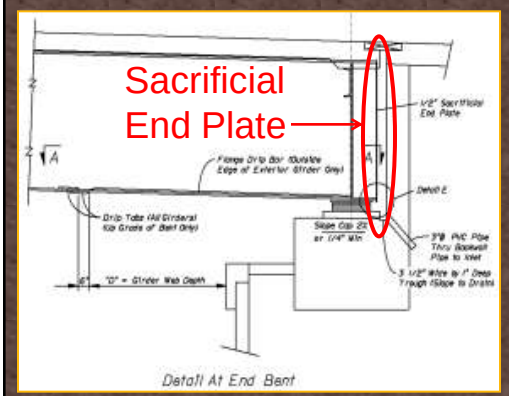
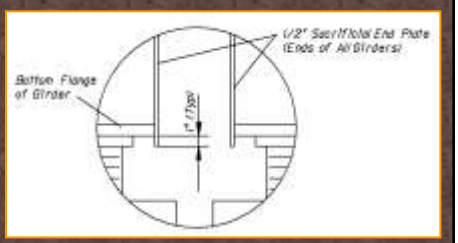
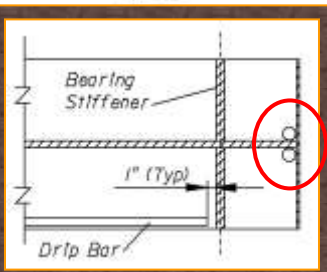
Weathering Steel Details



Girder End Treatment





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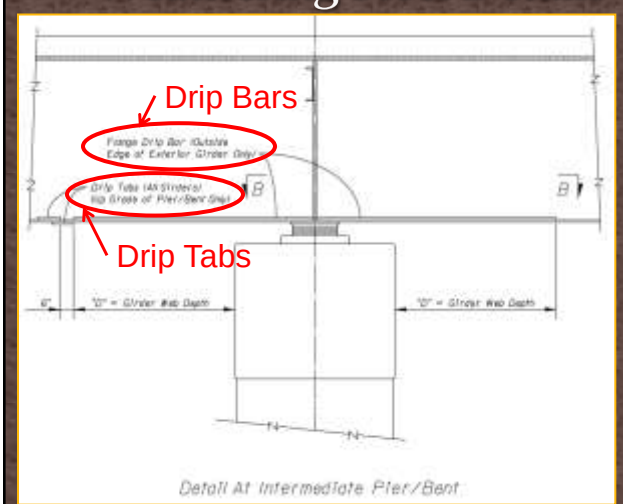
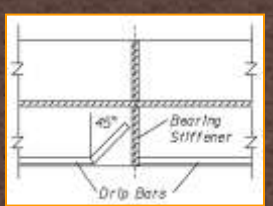
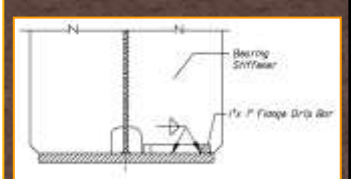
Weathering Steel Details







Treatment at Intermediate Piers
(Continuous Girders)

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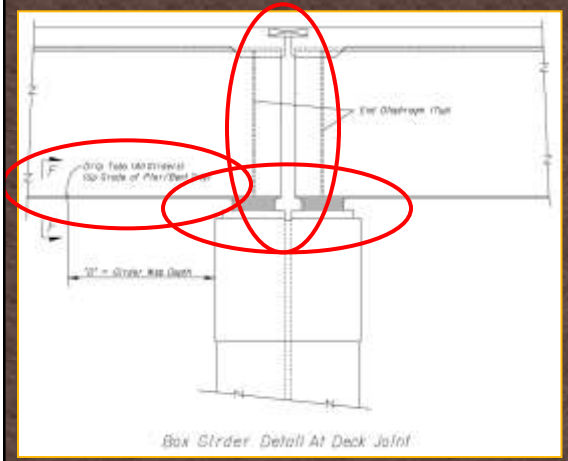
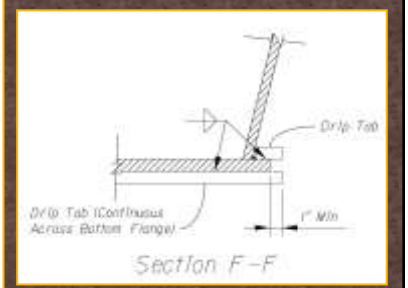
Weathering Steel Details



Box Girder Detail



Drip Tab Detail

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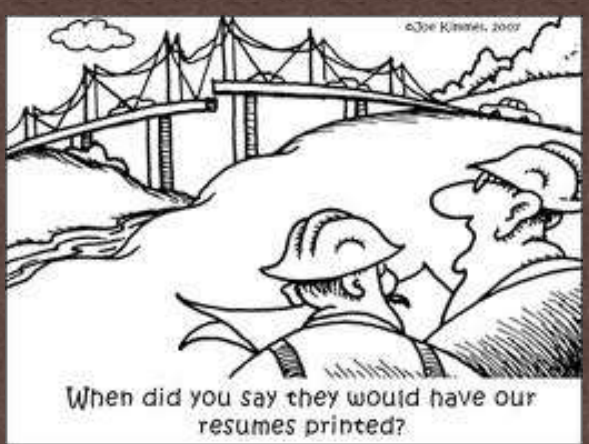
Uncoated Weathering Steel



Questions???

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